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ABSTRACT

This paper examines educational environments that promote learning and explores the ways that such environments produce differentially positive results. It is based on a study that investigated the effects of a theoretically based social-constructivist approach to education, in contrast to the more classroom-based "abstract" instruction used in middle-school environments. Ten middle-school teachers participated in the study. The teachers met over the summer and designed service-learning projects in which they wanted to be involved and in which they thought students would be interested. The teachers reported that project-based instruction afforded an opportunity for students to succeed where they might not have in a traditional classroom. Teachers learned personal things about students, how students approached tasks, students' level of understanding, and students' existing knowledge about the content areas of the school curriculum. The results show that students who were involved in projects achieved higher gains in standardized test scores than did students in the control group, despite 20 percent less academic instructional time, suggesting that student involvement in projects during the school day enhanced their performance. Students who were already achieving at high levels also benefited from the project. (Contains two tables of data and four references.) (RJM)

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An Experimental Test of Constructivist Educational Environments

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Fueled by the emphasis on school reform, over the past few decades there have been concerted attempts to ascertain the components of effective educational practice and of the characteristics of effective schools. Rarely, however, have these been grounded in a coherent developmental theory of how educational environments affect the growing cognitive competence of the child. Still rarer is the experimental test of theoretically derived treatments within a school setting.

Of particular relevance to studies of school effectiveness are theoretical approaches to how children acquire knowledge. A major school of developmental psychology may be characterized as a social constructivist perspective grounded in the theoretical work of Vygotsky (1978, 1987) as extended by others (e.g., Rogoff, 1990;). Three aspects of this theoretical work are of relevance to the organization of instructional environments. One is the nature of the processes by which children develop knowledge, a second is the role of the social environment, and a third is the role of motivational processes in the development of knowledge and thinking.

Vygotsky (1987) argues that children gain new knowledge through engaging in activities which are just beyond their current level of competence, within the Zone of Proximal Development (ZPD). They construct their new knowledge through scaffolding provided by adults or more competent peers. Rogoff (1990) uses the concept of 'guided participation' and asserts that this guided participation in culturally valued activities is essential for the construction of knowledge.

The role of adults or more competent peers in the construction of knowledge is more than simple promotion of cognitive development through guided participation. This guided participation must occur in the solution of problems arising in the course of socially shared and culturally meaningful activities. Through developing solutions to these problems children gain a sense of the importance and relevance of their activity to the social structure of which they are a part. Learning is initially interpsychological and occurs through social interaction in these problem solving activities. Only later does it become independently functioning within the individual. (Leontiev, 1981).

The motivation of the individual is also important in the acquisition of knowledge. Vygotsky (1987) held that thought originated in the motivations of the individual, including affective and volitional tendencies.

This theoretical approach suggests characteristics of educational environments which should prove differentially effective for educational environments in producing learning in students. These are: 1) teachers and students should be engaged in problem-solving activities in which they share interest and commitment; 2) these activities should involve problems of importance to the culture of which the participants are a part; and 3) these activities should provide opportunities for adults to provide scaffolding through guided participation in the solution of the problems taken on by the group

Another way of stating these characteristics is to suggest the contrasting conditions which would be inimical to the development of thought/knowledge from this perspective: Specifically, activities whose goals and objectives are imposed on teachers and/or students by external curricular

guidelines, are not seen as important or relevant within the student motivational system, which are not seen as important or contributing to cultural welfare, and which are not shared by teacher and student would lead to less good learning in students.

The current study was an attempt to create the conditions that would lead to the kinds of educational environments that would promote learning in the sense described above and to conduct an experimental test of the hypothesis that such environments produce differentially positive results relative to environments not so constructed.

Method

Program Design

Service-learning, a pedagogical approach characterized by engaging students and teachers in work which meets perceived community needs in ways related to the school curriculum, was seen as providing appropriate culturally important problems which need solving. Thus service-learning projects were adopted as a vehicle for the intervention to meet the problem solving criterion..

To meet the motivational and shared commitment criteria of the approach, conditions were created to ensure that individuals participating would be doing so voluntarily. Permission to conduct the pilot of this approach to designing educational environments at a middle school in a small Midwestern city was obtained from the district administration and the building principal. Meetings with building staff were held to inform them about the nature of service-learning, the nature of the proposed project, and to recruit volunteers. Ten teachers, four in the "exploratory" curriculum of the middle school (Family and Consumer Science, Exploratory Business, Industrial Technology, and Art), five in the "core" curriculum (English/Language Arts, Science, Social Science, Math, Health/PE) and a Special Education teacher either volunteered or were specifically hired for the project.

The teachers met over the summer and designed service-learning projects in which they wanted to be involved and in which they thought students would be interested. Five projects were agreed on as introductory projects and presented to students at the beginning of the year. Students rank ordered the projects and were assigned, as much as possible, to their first choice. New projects were developed over the course of the year as projects were completed or students indicated interests in other projects. The projects planned over the summer were: a quilting-making project a bird feeder watch project, a newsletter, and a toy making project. As the year progressed the following projects were added: a tutoring project, in which students visited grade- schools to work with elementary students, and an intergenerational project in which students visited a nearby nursing home.

As the school year progressed, teachers and students in the constructivist condition worked together t complete the service-learning projects that were planned over the previous summer or developed during the school year. Thus, teachers had the opportunity to provide scaffolding through guided participation in problem solving.

The non experimental team conducted instruction without time set aside for projects, did not plan projects as a team, did not reduce academic instructional period. In addition, the traditional team consisted of academic teachers only. Exploratory teachers did not participate in meetings or planning sessions with academic teachers in the traditional team.

Participants

Teacher participants were the ten teacher volunteers recruited as described above.

The particular middle school site contained grades 7-9. The student participants in the experimental group were 117 students selected at random from those entering the 7th grade. Control students were 165 students randomly assigned to a second (control) team of 7th grade teachers. Teachers were assigned to the control team by the school administration using normal assignment procedures. Random assignment of students to teams allowed control of special education status, ethnicity, SES, and the academic environment within the school.

Treatment

Students in the experimental group participated in service-learning projects two periods each day for the academic year. Instructional time in traditional academic or "core" subjects was reduced by 10 minutes per day in order to accommodate the projects. This reduction was not instituted in the control team.

Differences between the experimental and control teams were: 1) voluntary teacher participation on the experimental team based on commitment to carrying out the project as an alternative approach to education; 2) inclusion of exploratory teachers on the experimental team and not on the control team; and 3) shortened periods for academic content on the experimental team. Each team had a common planning period, however, the experimental team met at least twice weekly during the year, the control team did not meet regularly.

Data Collection

Data on teacher experience: In order to ascertain that a climate developed within the projects which involved shared commitments and motivations between students and teachers, an interview was conducted with each of the ten teachers on the experimental team. These interviews were analyzed to assess the contrast between what teachers experienced during the projects with their experience in more traditional academic instruction.

Student data: In order to assess the effects of participation in the projects on student achievement scores from the Metropolitan Achievement Test (MAT), including Total Battery, Total Reading, Language, Reading, Total Math, Math Concepts, and Math Process scores, were gathered for all students from the end of the 6th grade year and the end of the 7th grade year. Gains from 6th grade to 7th grade in the experimental students were compared to those of the control students.

Results

Teacher Interview Results

Teachers on the team were interviewed and asked about their experiences on the project team. The focus of the interviews reported here is the quilting project. The teachers reported that project-based instruction as constructed in this study afforded an opportunity for students to succeed when they might not in a traditional classroom Students and teachers had a chance to interact in ways that do not typically occur in the traditional way of teaching. Two teachers described the effect of working with students on constructing a quilt.

"When we are cutting fabric for the quilt, the kids talk about themselves and their families, " said Kim, the English teacher on the project team, "I learn things about them that I would never know otherwise." Stacy, the special education teacher on the team agrees: "I was closer to kids than I could be in a regular classroom."

Bev, who is a math teacher and the team leader of the project teaching team, described how the students had selected the fabric to make their individual squares, cooperated on fitting them together according to color and pattern, and sewn the squares into the into strips and then into a whole quilt. She told us that she had to do some of the sewing in the center of the quilt, because the long strips in the center required more skill and care to put together than the students had.

Bev talked about how the students had seen the quilt in its put-together form for the first time the day before. She told us that the students' "eyes lit up". Bev described how one girl had melodramatically wrapped herself in the quilt and said "We are all a part of the quilt".

Stacy, the special education teacher on the project team, had pictures of all the students on the project pasted on small circles of yellow construction paper. These pictures were displayed on a map of the city. Pins of different colors had been put into the map to mark the locations of the homes of of students and teachers in the project team. Stacy described how the students who helped her cut to paper and pictures and glue them together talked about the year as they worked with her. She told about how they talked about how they had changed, and how their fellow students in the pictures had changed over the year. Stacy described how the students talked about how they had grown, how they were different. The map and the quilt were records of the time the students had spent in the project.

Teachers on the experimental team reported that working with students on the projects allowed them to learn more about students than they would have in a traditional classroom. They learned personal things about students, as well as how students approached tasks, the level of their understanding, and their existing knowledge about the content areas of the school curriculum.

Teachers also reported that the projects were demanding in terms of personal resources. Because the projects required planning and resource allocation (e.g. purchase of quilting material and thread), teachers felt pressed to adequate plan for their academic instruction periods. As participants in an experiment, they reported feeling that the other teachers in the school disapproved of the way students were being instructed during the project time. Because truncated academic periods put the project team at adds with the end of period and beginning of period bell schedule, office personnel and other teachers often did not respect the integrity of the academic periods. One of the project teacher described the problem: "We are often interrupted during instruction by messengers from the office e, or by other teachers looking for students or asking for reports. If we were on the bell schedule, these requests would be made between periods."

In sum, teachers described the benefits of the project method as follows:

1) Teachers developed closer personal and working relationships with each other

2) Teachers felt they got to know students better than in previous years.

3) During the project time, disciplinary problems were less frequent.

4) Students were able to succeed in ways that were surprising to teachers.

5) Students were exposed to new experiences, ideas and possibilities.

Teachers identified several problems with the experimental instructional method:

1) Teachers felt that planning and reflective time was inadequate considering the demands of the projects.

2) Teachers had to contribute their own money to fund parts of the projects.

3) Teachers reported that school office personnel did not respect the project schedules and often interrupted instruction.

Analysis of the teacher interviews revealed that the teachers described their experience in the experimental year by saying that they developed closer relationships, both with each other and with the

students. They got to know more about students than they usually did and saw students succeed who might not have been successful in a traditional classroom. The development of shared commitment was illustrated by the comment of one seventh grader when she said, "We are all a part of the quilt." These interviews demonstrated that the conditions we set up did, in general, establish the sense of shared commitment and community which is important to achieve within our conception of the Vygotskiian framework.

Student Achievement Results

A repeated measures ANOVA revealed that the gains on the Total Battery of the MAT for the experimental group were significantly higher than for the control group ($F = 5.63$, $p > .02$). Effect size was small (Eta sqr.= .024). The treatment groups improved a small amount, while the control group's performance declined slightly. Examination of the gains on the subscales revealed that gains on the math portions of the MAT contributed most to the difference in basic batters scores (see Table 3). Scores in the treatment group increased substantially for total math, compared to a small increase for the control group (see Tables 1 and 2).

Discussion

This study provided an experimental test of an intervention in a public school setting of a social constructivist approach based on the theoretical work of Vygotsky (1978, 1987) as extended by Rogoff (1990) to the design of educational environments. In this experiment, teachers volunteered to pilot an approach to education designed to allow them the freedom to construct educational environments in which students and teachers contributed to solving culturally important problems and within which the teachers could provide guided practice to students in activities for which both were motivated partners. Significant gains in scores on the Metropolitan Achievement Test relative to students on a team which carried out the "traditional" curriculum shows that this approach can be an effective means of promoting traditionally conceived educational goals. It is particularly noteworthy that test score gains were achieved even though students in the experimental group had the equivalent of one day per week *less* instruction in the traditional curriculum than did students in the control group. This result suggests that strict control of the curriculum and emphasis on academic preparation for standardized tests are not essential for the improvement of test scores under the conditions of this experiment.

A common assumption is that project based instruction is better for students who are at lower levels of achievement. A *post hoc* analysis in which gains on the MAT for the experimental students were compared with those of the control students by quartile of 6th grade MAT scores revealed that there were no differences in gains by quartile. That is, students who achieved in the higher quartiles gained just as much from the experimental treatment as did students in the lower quartiles.

Conclusions

The opportunity for an experimental design afforded by this study allowed the opportunity to explore the effects of a theoretically based social-constructivist approach to education in contrast to the more classroom-based, "abstract" instruction used in this middle school environment. While the teachers in the experimental group volunteered to participate in the experiment and the teachers in the control group did not, we were able to control for student characteristics through random selection. The fact that we achieved higher gains in standardized test scores in the experimental group than in the control group despite 20% less academic instructional time suggests three things: 1) Involvement of students in projects meaningful to them during the school day not only does not interfere with their

performance on standardized tests, it enhances it. 2) Such involvement is beneficial to all students. 3) Standardized tests can assess the gains that students achieve through involvement in such projects.

Further studies should be done to replicate these results, and additional study is needed to assess the effects of different types of projects. Service-Learning projects were chosen for this study because they met the criteria for involvement of students in culturally meaningful activities in partnership with adults. A further test of the theory would investigate differences between classroom based projects which students do in conjunction with each other and the socially involved projects exemplified by service-learning.

It is interesting that the test performance of students who are already achieving at high levels was enhanced by participation in these projects. This suggests that the benefits of meaningful, real-life projects chosen by students extend to all students, and that students who participate in these projects will not be penalized in their academic progress. These projects can be truly inclusive and accommodate diverse student populations without detrimental effects on any group.

The theory behind standardized tests is that they provide a sample of student behavior which is indicative of their underlying knowledge and skills. However, the importance of test scores has increased to the point where high scores have become the "goal." The results of this study should provide confidence to educators that if they do what is good for kids, good test scores will follow. Perhaps the problem with standardized tests is not the test itself, but the effects which follow from attempting to teach to the test. Perhaps those efforts are truly counterproductive.

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Table 1.
Means and standard deviations for MAT tests, end of 6th grade.

Traditional instruction team:

Test	Mean	Std Dev	n
Basic battery	45.73	21.03	161
Total math	45.65	22.38	163
Math process	44.01	21.22	165
Math concept	47.07	22.27	165
Total reading	45.67	19.74	162
Vocabulary	45.55	21.00	163
Reading comp	46.20	19.03	163
Language	45.34	20.29	167

Service-Learning team:

Test	Mean	Std Dev	n
Basic battery	45.13	20.07	99
Total math	45.85	22.09	99
Math process	44.15	19.64	99
Math concept	47.53	22.43	99
Total reading	44.38	18.84	99
Vocabulary	47.11	19.48	99
Reading comp	43.74	18.64	99
Language	46.45	17.71	99

Table 2.
Means and standard deviations for MAT tests, end of 7th grade.

Traditional instruction team:

Test	Mean	Std Dev	n
Basic battery	45.02	20.99	162
Total math	47.33	21.19	163
Math process	39.74	19.44	165
Math concept	47.25	22.92	166
Total reading	45.05	19.90	165
Vocabulary	47.73	21.74	165
Reading comp	44.36	18.92	166
Language	42.10	20.61	166

Service-Learning team:

Test	Mean	Std Dev	n
Basic battery	46.26	22.12	95
Total math	50.98	22.74	96
Math process	43.99	22.58	97
Math concept	51.00	23.53	99
Total reading	44.53	20.73	99
Vocabulary	47.87	21.35	99
Reading comp	43.86	19.59	99
Language	44.45	19.46	97

Table 3.

Repeated measures ANOVA table of comparison between service-learning team and traditional instruction team in terms of Metropolitan Achievement Test score changes from end of 6th to end of 7th grades.

	SS	DF	MS	F	Sig of F
Team by basic battery	152.16	1	152.16	5.63	.019
Team by total math	575.58	1	575.58	11.14	.001
Team by total reading	.17	1	.17	.00	.951
Team by language	91.23	1	91.23	1.46	.228

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